(54) Title: METHOD FOR MANAGING RESOURCES ALLOCATED IN A COMPUTER
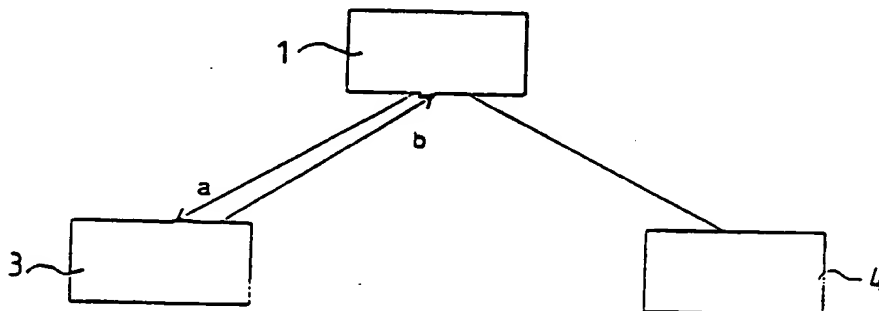
(57) Abstract

The invention relates to a method for managing resources allocated in a computer, wherein the allocated resources are maintained or released by time monitoring. In the invention, a task controller (1) is allocated for the management of resources re-quired for a task to be executed; the controller (1) allocates resources (3, 4) required to execute the task; the controller starts time monitoring in each resource; if required by the task, the controller renews the resource allocations before the expiry of the respec-tive time monitoring periods; and the controller (1) releases all resources allocated for the task after the completion of the task.

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Method for managing resources allocated in a computer

This invention relates to a method for managing
resources allocated in a computer, wherein the alloc-
ated resources are maintained or released by time
monitoring.

The execution of a specific task in a computer
system often requires co-operation between several
resources based on recurrent use of the hardware,
software and/or memory resources. The use of resources
thus refers to the allocation of the parts of the
computer system for the execution of a specific task,
no matter whether these parts belong to the hardware,
computation or memory capacity of the computer.

The resource allocation system has been problem-
atic in that the known computers do not comprise any
particularly advanced systems for monitoring allocated
resources. Especially after the completion of the task
assigned to the computer, the release of all or some
of the resources may fail for some reason, e.g. due to
malfunction, a programming error, etc. In practice,
this problem easily results in that the system runs
short of certain kind of resources in the long run, or
that there are needlessly allocated resources in the
system for long periods of time. This in turn reduces
the capacity and may finally cause the operation to
cease if all resources of a certain type have been
allocated for one or more tasks which have been
completed a long time ago.

One solution to the problem is offered by fixed-
time monitoring which can be used in cases where it is
possible to determine a maximum duration for the task
to be executed by the resource. The resource is alloc-
ated for the maximum period of time, after which the
resource releases itself if it has not yet been

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released. Periodic monitoring has been used for re-
sources allocated for an indefinite period of time or
for resources allocated for a very long period of
time. It is thereby checked intermittently that all
5   resources in the system have changed tasks. If this
has not happened, it is checked whether the main task
is still uncompleted throughout the system, on the
basis of which the resources are then released or
maintained unchanged. One application of this proced-
10   ure is the virtual memory management, in which the
central memory is divided into pages (resources), and
the use of different memory pages is monitored during
the execution of a program. Unused pages are replaced
with new pages from a mass memory whenever required. A
15   disadvantage of periodic monitoring is that it loads
the system and is complicated, as the monitoring pro-
cedure that checks all allocated resources has to be
started intermittently, and if the system has to
operate in parallel with the checking routine, a very
20   complicated management algorithm will result as new
resources are allocated all the time while old ones
are released. In addition, a priority conflict occurs
in the fixed-time monitoring of long tasks between the
monitoring frequency and the execution if the average
25   required allocation time is only a fraction of the
time required for the entire task so that there occur
needlessly allocated resources within the time
monitoring. For instance, the memory pages to be
replaced in the virtual memory management are not
30   released until required, i.e. the central memory may,
in principle, be filled up, which reduces the capacity
of the system e.g. during the execution of background
routines which do not use the virtual memory.

            The object of the present invention is to solve
35   the resource management problems by eliminating

resource allocations in cases where the resource remains needlessly allocated for an indefinite period of time. To achieve this, the method according to the invention is characterized by

5   allocating a task controller for the management of resources required for a task to be executed;

allocating by the task controller resources required to execute the task;

starting time monitoring in each resource by
10 the controller;

renewing the resource allocations by the controller before the expiry of the respective time monitoring periods, if required by the task; and

releasing by the controller all resources
15 allocated for the task after the completion of the task.

The task controller according to the invention thus operates so that when it allocates a resource for the execution of a specific task, it also requests the
20 resource to start the time monitoring itself for a period of time which is either equal to the maximum allocation time when this suits the nature of the task, or with a resource to be allocated for an indefinite period of time, the allocation time depends
25 on the distribution of use so that e.g. 90% of all cases (on a statistical basis) are processed within the allocation time. The method according to the invention is suitable for the management of both hardware resources (HW) and software resources (SW,
30 e.g. memory buffers). The method is very reliable in operation as its operability is based on time monitoring, and all error situations can be handled simply by a restart. The method according to the invention is also operative in an environment in which communica-
35 tion between different resources is unreliable. The

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method supports well the modern modular and object-oriented programming methods.

Other preferred embodiments of the method according to the invention are characterized by what is disclosed in the accompanying claims.

In the following the invention will be described by means of examples with reference to the attached drawings, in which

Figures 1a to 1c illustrate the resource management sequence of the method according to the invention in a normal case;

Figure 2 illustrates the renewal of a resource allocation; and

Figures 3a to 3c illustrate various resource allocation release situations.

In Figure 1a, a computer system, such as a central unit 2, i.e. the external environment from the viewpoint of a task to be executed, allocates a controller 1 for the task. The controller may be a hardware or memory area resource capable of controlling other resources in a co-ordinated manner. The controller may be scheduled to release itself spontaneously after the expiry of a fixed time if the external environment 2 does not separately renew it, or it may be releasable by the external environment 2 only.

In Figure 1b, the controller 1 allocates required resources from the computer system; in this specific case, it allocates a read circuit 3 and a memory buffer 4 of a keyboard (not shown) as hardware resources. The task assigned to the controller is thus to read characters from the keyboard to the memory buffer. Moreover, the controller starts a separate time monitoring in the keyboard read circuit and memory buffer 4. The time monitoring period may vary

from one resource to another, being e.g. 60 seconds in
the read circuit 3 and 120 seconds in the memory
buffer 4. As mentioned above, the resources can be
allocated on the basis of the maximum time reserved
5   for the task or on the basis of the probable task
duration.

        After this the time monitoring of the resources
.does not strain the controller or any other part of
the computer system but each resource monitors itself
10 in this respect. Time monitoring can be realized e.g.
by a simple time counter program which is attached to
the program controlling the operation of each resource
or is activated in the program or hardware resource.

        In Figure 1c, the system executes a given task
15 by using the allocated resources, and after the task
is completed, all resources are released immediately.
Communication with the resources takes place via the
controller 1. If the controller has been allocated for
a fixed period of time, its possible renewal has to
20 take place here, prior to the release of the con-
troller's own time monitoring.

        Figure 2 shows a case in which the renewal of a
resource is required to complete the task. If the
resources allocated in Figure 1b have been allocated
25 for 50 seconds, and the task has not yet been com-
pleted, the controller 1 renews the allocation of the
read circuit 3 by a renewal request a for another 60
seconds. The buffer 3 thereby acknowledges (arrow b)
the further allocation to the controller, or does not
30 accept/does not respond to the renewal request so that
the controller can also release itself.

        The hand-shaking according to the invention
ensures that the resources remain needlessly allocated
for no more than the duration of the time monitoring
35 of the particular resource. The resource is released

on the basis of the time monitoring only when it is
not released by the controller after the completion of
the task, i.e. when the resource might otherwise
remain allocated for an indefinite period of time;
5   the renewal of allocation is required only seldom,
depending on the given use distribution parameters,
e.g. in 10% of all cases. Accordingly, the resource
management binds very little capacity in the method
according to the invention.
10   The minimizing of the duration of the time
monitoring and the minimizing of the number of renewal
requests are mutually contradictory objectives depend-
ing on the reliability of the system and the available
capacity, whereby the required compromise is deter-
15   mined by parametrization, i.e. fixed parameters
specific to the central unit, or computed parameters
optimized for each task, for instance.
          Correspondingly, the allocation of the memory
buffer 4 in Figure 2 is renewable, if required, after
20   110 seconds from the start of the task. After the
renewal of the allocation one returns to the situation
shown in Figure 1c to wait for the completion of the
task.
          Figure 3a shows a situation in which a system
25   part (in this specific case the read circuit 3) is
damaged and/or incapable of communication. The follow-
ing renewal request a of the allocation of the task
controller 1 thereby fails (the acknowledgement b will
not be received), and so the controller 1 releases
30   itself, possibly after having sent an indication c of
the failure of the task to its starter (the central
unit).
          In the situation shown in Figure 3b the fixed-
time monitoring at the memory buffer 4 is released,
35   and the memory area is freed. This situation typically

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results from the hardware failure described in con-
nection with Figure 3a or from the malfunction of the
controller. Accordingly, all resources are released
when the respective time monitorings are released even
5   though the communication between the resources would
be unreliable.

Figure 3c shows a case in which the task con-
troller fails or its allocation for a predetermined
time is not renewed so that it is released. Thereafter
10   all other allocated resources are released in accord-
ance with their own time monitoring procedures if
there are no renewal requests.

It is obvious to one skilled in the art that the
different embodiments of the invention are not limited
15   to the illustrating embodiments described above but
they may vary within the scope of the attached claims.

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Claims:

1. Method for managing resources allocated in a
computer, wherein the allocated resources are main-
5   tained or released by time monitoring, c h a r a c-
t e r i z e d by
allocating a task controller (1) for the manage-
ment of resources required for a task to be executed;
allocating by the task controller (1) resources
10 (3, 4) required to execute the task;
starting time monitoring in each resource by the
controller;
renewing the resource allocations by the con-
troller before the expiry of the respective time
15 monitoring periods, if required by the task; and
releasing by the controller (1) all resources
allocated for the task after the completion of the
task.

2. Method according to claim 1, c h a r a c-
20 t e r i z e d in that the task controller (1) is
formed as a resource provided with time monitoring.

3. Method according to claim 1 or 2, c h a r -
a c t e r i z e d in that when the time monitoring
period of each resource (1, 3, 4) expires without a
25 renewal, the resource is released spontaneously.

4. Method according to claim 1, 2 or 3, c h a r-
a c t e r i z e d in that the time monitoring period
of each resource (1, 3, 4) is determined on the basis
of the maximal execution time of the task.

30 5. Method according to claim 1, 2 or 3, c h a r-
a c t e r i z e d in that the time monitoring period
of each resource (1, 3, 4) is determined on the basis
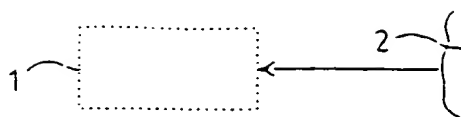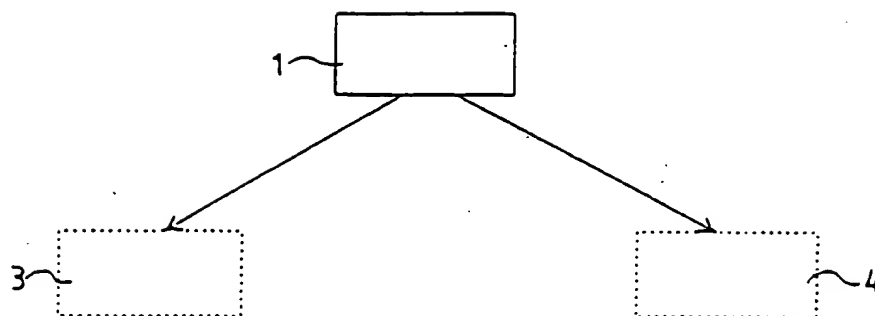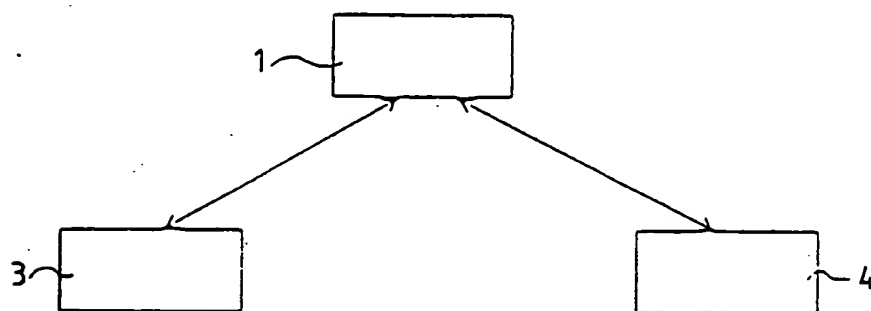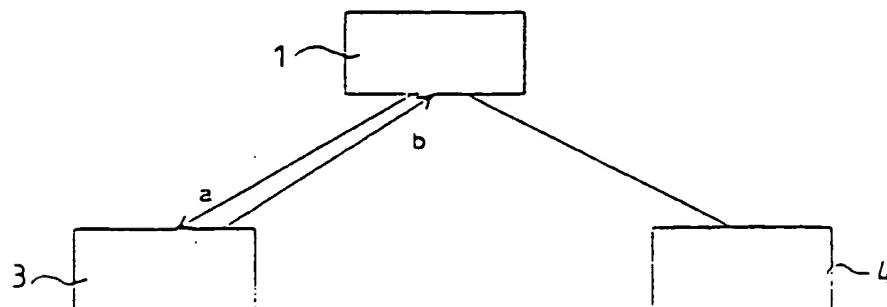of the probable execution time of the task.

FIG.1a

FIG.1b

FIG.1c

FIG.2
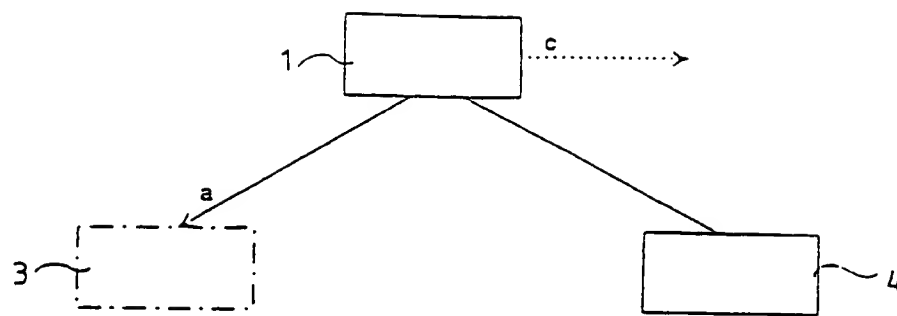
FIG. 3a
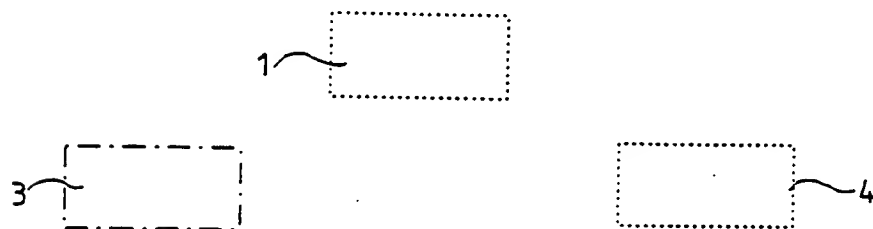
FIG. 3b
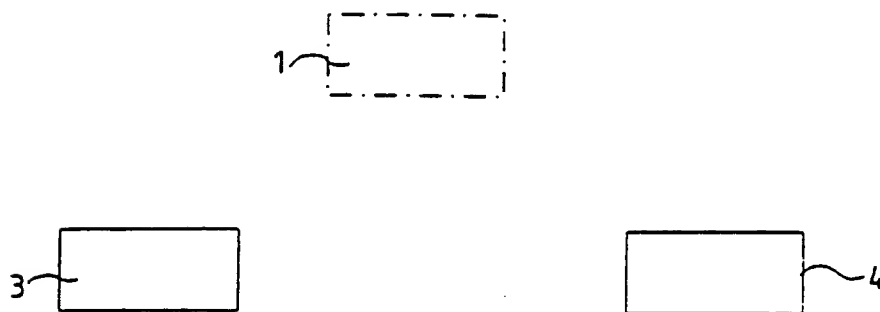
FIG. 3c

INTERNATIONAL SEARCH REPORT

	International application No.
	PCT/FI 93/00304

A. CLASSIFICATION OF SUBJECT MATTER

IPC5: G06F 9/46

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC5: G06F

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

SE,DK,FI,NO classes as above

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

DIALOG 340, 347, 350, 351

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US, A, 4635187 (DONNA M. BARON ET AL), 6 January 1987 (06.01.87), column 2, line 5 - line 41 --	1-5
A	EP, A2, 0094841 (WESTERN ELECTRIC COMPANY, INCORPORATED), 23 November 1983 (23.11.83), figure 1, abstract --	1-5
A	US, A, 4435766 (JUDITH G. HABER ET AL), 6 March 1984 (06.03.84), abstract --	1-5

☐ Further documents are listed in the continuation of Box C.	☒ See patent family annex.

* Special categories of cited documents:
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"Y" document of particular relevance: the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
28 October 1993	03 -11- 1993

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International application No.

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		DE-A-	3468556	11/02/88
		EP-A,B-	0165934	02/01/86
		SE-T3-	0165934	
EP-A2- 0094841	23/11/83	EP-A-	0110950	20/06/84
US-A- 4435766	06/03/84	JP-C-	1605016	13/05/91
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